21. In apparatus for irradiating a selected region of a target material containing an excitable species in order to excite members of said species, including a source of exciting radiation adapted to exciting said members and focusing means to focus said radiation to said selected region, a method of increasing the resolution of said apparatus including the steps of:

providing a second type of radiation able to reduce the excitation of said species by said exciting radiation;

applying said second type of radiation to said selected region to preferentially decrease the excitation in a chosen part of said region, thereby increasing the resolution of said apparatus,

22. The apparatus in Claim 21 and including the additional step, for at least one point in said selected region, of reducing to substantially zero the net intensity of radiation of said second type intentionally directed on said point, such that substantially the only radiation of said second type arriving at said point is from unavoidable scattering in said apparatus and said target material.

23. The apparatus in Claim 22, wherein the step of reducing to substantially zero the net intensity of radiation of said second type intentionally directed on said point includes the additional steps of providing a first source of said second type of radiation directed on said point, and a second source of said second type of radiation directed on said point, coherent with said first source, and adapted to destructively interfere, at said point, with the radiation from said first source of said second time of radiation, such that the net intensity of said second type of radiation at said point is substantially zero.

24. The apparatus in Claim 21, including the additional step of producing a first interference pattern of said second type of radiation within said selected region.

25. The apparatus of Claim 24 wherein said first interference pattern has a node substantially extended in at least one dimension.

26. The apparatus of Claim 25 including the additional step of producing a second interference pattern of said second type of radiation within said region, substantially extended in at least one dimension different from said dimension in Claim 25.

27. The apparatus of Claim 26, including a step insuring that radiation of said second type in said first interference pattern substantially does not interfere with radiation of said second type in said second interference pattern.

28. The apparatus of Claim 27, wherein said step insuring that radiation of said second type in said first interference pattern substantially does not interfere with radiation of said second type in said second interference pattern includes a step from the class including producing said interference patterns at different times, producing said interference patterns from radiation of different wavelengths, producing said interference patterns from mutually incoherent radiation, and producing said interference patterns from mutually coherent radiation but having phase difference of 90° and 270°.

29. The apparatus of Claim 26, wherein said focusing means has an axis, wherein the radiation from said first interference pattern increases resolution in a first direction substantially perpendicular to said axis, and wherein the radiation from said second interference pattern increases resolution in a second direction both substantially perpendicular to said axis and also different from said first direction.

30. The apparatus of Claim 26, wherein said focusing means has an axis, wherein the radiation from said first interference pattern increases resolution in a first direction substantially perpendicular to said axis, and wherein the radiation from said second interference pattern increases resolution in a second direction substantially parallel to said axis.

31. The apparatus of Claim 21 wherein said focusing means has an axis, and including means to improve resolution in two mutually perpendicular dimensions perpendicular to said axis and additional means to improve resolution in the dimension parallel to said axis.

32. The method of Claim 21 wherein said radiationally excitable species are in a class including:

fluorescent molecules in a target material to be examined;

molecules in a target material consisting of a recording medium encoding information;

molecules in a target material adapted to undergo a long term change in at least one property following exposure to said exciting radiation; and

molecules in a photolithographic resist.

33. The method of Claim 21 wherein said apparatus is adapted to simultaneously irradiate a plurality of non-adjacent regions in said target material with exciting radiation, forming in each said region a central maximum of exciting radiation, and for each of said irradiated regions, to direct said second type of radiation so that a central minimum of said second type of radiation overlaps with the central maximum in the region, thereby simultaneously improving the resolution for each of the irradiated regions.

34. The method of Claim 21, and including an additional steps of measuring radiation emitted by the irradiated portion of said material and substantially preventing said second type of radiation from being included in the measurement of the radiation emitted by the irradiated portion of said material.

35. The method of Claim 34 wherein said measuring step uses a radiation detector and wherein said additional step for substantially preventing said radiation of said second type from being included in the measurement includes the use of an optical filter substantially opaque to said radiation of said second type, said filter being located in the optical path between said target material and said radiation detector.

36. The method of Claim 34 including the additional step of delivering said exciting radiation in short pulses and delivering said second type of radiation in short pulses which follow said pulses of exciting radiation, and wherein said additional step for substantially preventing said second type of radiation from being included in the measurement includes a step of gating the measurement off during said short pulses of said second type of radiation.

37. The method of Claim 21, wherein said species has an excitation spectrum with at least one band where radiation of a wavelength within said band produces substantially no excitation of said species, and including the step of substantially preventing the said second type of radiation from exciting said members by the step of providing the second type of radiation of a wavelength within said band.

38. The method of Claim 21 wherein said exciting radiation excites members of said species by a two-photon process and wherein said second type radiation interacts with said material by a one-photon process.

39. In apparatus for irradiating a selected region of a target material containing an excitable species in order to excite members of said species, including a source of exciting radiation adapted to excite said members and focusing means to focus said radiation to a pattern having a central maximum at said selected region, mean for increasing the resolution of said apparatus including:

means for providing a second type of radiation able to reduce the excitation of members by said exciting radiation; and

means for directing said second type of radiation to said selected region so as to preferentially decrease the excitation in a chosen part of said region, thereby increasing the resolution of said apparatus.

40. In apparatus for irradiating a selected region of a target material containing a radiationally excitable species in order to excite members of said species, including a source of exciting radiation adapted to excite said members and focusing means to focus said radiation to a pattern in a focal plane at said material, said pattern having a central maximum, means for increasing the effective resolution of said focusing means including:

means for providing a second type of radiation able to reduce the excitation of said species by said exciting radiation;

means for shaping said second type of radiation into a pattern with a central minimum, whereby within the central minimum, the intensity of said second type of radiation substantially increases with distance from the center of the central minimum; and

means for overlapping said central minimum with said central maximum, whereby, within said central minimum, the likelihood that said second type of radiation will reduce said excitation increases with the distance from the center of said central maximum.